UNIVERSITY OF CALIFORNIA PUBLICATIONS

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

BERKELEY, CALIFORNIA

THE MILCH GOAT IN CALIFORNIA

BY

EDWIN C. VOORHIES

Fig. 1.—Does on the University Farm.

BULLETIN No. 285

September, 1917

UNIVERSITY OF CALIFORNIA PRESS

BERKELEY

1917

BENJAMIN IDE WHEELER, President of the University.

EXPERIMENT STATION STAFF

HEADS OF DIVISIONS

THOMAS FORSYTH HUNT, Director.
EDWARD J. WICKSON, Horticulture (Emeritus).
HERBERT J. WEBBER, Director Citrus Experiment Station; Plant Breeding.
HUBERT E. VAN NORMAN, Vice-Director; Dairy Management.
WILLIAM A. SETCHELL, Botany.
MYER E. JAFFA, Nutrition.
*ROBERT H. LOUGHRIDGE, Soil Chemistry and Physics (Emeritus).
CHARLES W. WOODWORTH, Entomology.
RALPH E. SMITH, Plant Pathology.
J. ELIOT COIT, Citriculture.
JOHN W. GILMORE, Agronomy.
CHARLES F. SHAW, Soil Technology.
JOHN W. GREGG, Landscape Gardening and Floriculture.
FREDERIC T. BIOLETTI, Viticulture and Enology.
WARREN T. CLARKE, Agricultural Extension.
JOHN S. BURD, Agricultural Chemistry.
CHARLES B. LIPMAN, Soil Chemistry and Bacteriology.
CLARENCE M. HARING, Veterinary Science and Bacteriology.
ERNEST B. BABCOCK, Genetics.
GORDON H. TRUE, Animal Husbandry.
JAMES T. BARRETT, Plant Pathology.
FRITZ W. WOLL, Animal Nutrition.
WALTER MULFORD, Forestry.
W. P. KELLEY, Agricultural Chemistry.
H. J. QUAYLE, Entomology.
ELWOOD MEAD, Rural Institutions.
J. B. DAVIDSON, Agricultural Engineering.
H. S. REED, Plant Physiology.
D. T. MASON, Forestry.
†FRANK ADAMS, Irrigation Investigations.
C. L. ROADHOUSE, Dairy Industry.
W. L. HOWARD, Pomology.
WILLIAM G. HUMMEL, Agricultural Education.
JOHN E. DOUGHERTY, Poultry Husbandry.
S. S. ROGERS, Olericulture.
DAVID N. MORGAN, Assistant to the Director.
Mrs. D. L. BUNNELL, Librarian.

DIVISION OF ANIMAL HUSBANDRY

GORDON H. TRUE
F. W. WOLL
J. G. THOMPSON
R. F. MILLER
EDWIN C. VOORHIES
R. P. ROYCE

---

* Died July 1, 1917.

† In co-operation with office of Public Roads and Rural Engineering, U. S. Department of Agriculture.

THE MILCH GOAT IN CALIFORNIA

By EDWIN C. VOORHIES

This bulletin is published in response to numerous requests that have been received for information in regard to the value of milch goats under the conditions existing in this state. It has been deemed advisable to include in the discussion some general information on the subject of milch goats, as well as an account of the experimental work done with this class of farm animals at the University Farm up to the present time.

The discussions given in the following pages are accordingly presented under two headings, (*a*) General Information Concerning Milch Goats; (*b*) Results of Experimental Work, 1914–1916.

(A) GENERAL INFORMATION CONCERNING MILCH GOATS

Milch goats are kept for milk production in many foreign countries, especially in Continental Europe, Great Britain, Scandinavia, and in the countries bordering the Mediterranean. They are found in limited numbers in different states in the Union, and are doubtless more numerous in this state than elsewhere in the United States. They are generally kept in very small herds that supply the milk used by the family. A relatively small number of large herds is found in California, especially in the southern part. The comparatively dry climate of this state agrees well with milch goats, and they are kept on land differing greatly in topography and feed conditions. If sufficient feed is available, hilly and even rocky land can be used for goat keeping. Goats do not thrive well on low, damp, or swampy land as the conditions on such land are conducive to foot rot and other troubles. Provided they are properly cared for, goats will do well on well-drained valley land.

Alfalfa furnishes an abundant feed supply in the interior valleys, which could be utilized in goat keeping as at the present time for dairy cattle and other classes of livestock. In most places, where alfalfa cannot be grown successfully, other pasture crops well adapted for feeding goats can be raised to advantage, such as clover, vetch, rape, and peas. To the majority of goat keepers in this state as elsewhere, however, the main sustenance is found in feed growing in waste places, on vacant city lots, along roadways and fences, or on hill lands where there is not sufficient available feed for keeping

a cow. Goats thus largely derive their living from feed that would otherwise go to waste, which accounts for their popularity among people in urban communities and for the fact that they are generally considered most economical milk producers. The present conditions and possible extension of the milch goat industry in this state will be further discussed in another place in this bulletin.

BREEDS OF MILCH GOATS

There are many different breeds of milch boats, but comparatively few of these are represented in California, those present in large numbers being the Toggenburg, Saanen, and Anglo-Nubian. A great variety of crosses and numerous goats of no particular breeding are also found.

Toggenburg.—This breed is at the present time the most numerous in this state. It has its native home in the Toggenburg Valley, Switzerland, where it has been bred for centuries. The prevailing color is brown, both light and dark, with white markings. A white bridle mark is always present on each side of the face. White is also present on the underline and on the legs below the knees and hocks. White is also now and then found on the sides of the animal. As a rule, they are hornless, but horns are sometimes developed. The head is rather long, facial lines straight or slightly concave, ears of a medium size, more or less erect, although sometimes held almost horizontally. The neck is somewhat long and slender and there way or may not be wattles at the base of the lower jaw. Toggenburgs usually have a beard, which on the male is long and heavy. The better specimens of the breed are always lean and of medium size, females weighing about 100 to 140 pounds, while bucks as a rule weigh from 110 to 140 pounds. Both long-haired and short-haired animals are often seen in the same herd. It has been our experience that the Toggenburgs are very hardy and make splendid mothers.

Saanen.—This is another Swiss breed which is quite similar to the Toggenburg in general conformation. They are a little heavier in weight, mature bucks weighing from 175 to 200 pounds and does from 110 to 140 pounds. They are of a white or cream color, and usually short-haired. The Saanen is considered a hornless breed, but horns often occur as in the case of the Toggenburg. The Saanen may be used to great advantage in grading up herds in this state, as many of the common goats are white in color.

Nubians or Anglo-Nubians.—This goat is probably the result of a cross between the common short-haired goat of England and the

Fig. 2.—Toggenburg buck Prince Bismarck, No. 159 A. M. G. R. A.
(Courtesy of Winthrop Howland, Redlands, Cal.)

Fig. 3.—Toggenburg doe El Chivar's Geneva, No. 637 A. M. G. R. A. Grand Champion Toggenburg doe, P. P. I. E., 1915. Record, 2158 lbs. milk in 312 days.

Nubian, Egyptian, Abyssinian, Chitral, or some other oriental breed of goats. They have a short coat of no fixed color, all colors and combinations being found. The ears are long, wide and pendant or semi-pendant. The facial line is arched with a slight taper toward the muzzle. The eyes are large and full and the forehead wide. The kids are relatively large and grow rapidly.

Large numbers of goats are found on the Catalina Islands in a semi-wild state from which occasional specimens have been brought

Fig. 4.—Saanen buck King Franz, No. 915 A. M. G. R. A.
(Courtesy of L. A. Bridinger, Santa Rosa, Cal.)

to the mainland and domesticated. In some cases these have proved good milch animals. The same holds true in the case of goats from Mexico and the Guadalupe Island, off the coast of Mexico.

THE MILK OF THE GOAT

One of the first questions usually asked about milch goats is in regard to the quantity and quality of milk produced. Milch goats are similar to dairy cows in that some do not yield a sufficient quantity of milk to pay for their keep, while others are profitable dairy animals.

A good goat should give 800 to 1000 pounds (approximately 400–500 quarts) during a lactation period. Many breeders speak of the production of their animals in rather uncertain terms, such as a four-quart doe, a three-quart doe, etc. This refers to the production for a single day during the maximum flow of milk. The individuality of the animal is the greatest factor influencing milk production. Breed is also an important factor. The Toggenburg and Saanen are, as a rule, heavy milkers, while but little is definitely known in regard to

Fig. 5.—Saanen doe Juare (imported).
(Courtesy of R. R. Glahn, Los Angeles, Cal.)

the production of the other breeds in this state at the present time. Pegler states that the Anglo-Nubian is a good milker of rich milk, containing more butter-fat than that of Swiss goats, although the yield is not as a rule as large.[1]

The Toggenburg doe, Fanette, owned by Mr. Winthrop Howland of Rancho El Chivar, Redlands, California, is reported as giving 2680 pounds of milk in twelve months. Five does of the same breed on the University Farm yielded 2148, 1553, 1341, 1283, and 1090 pounds of milk during a lactation period of twelve, eleven, eleven, ten,

[1] Pegler, *The Book of the Goat*, p. 31.

and eight months, respectively. These records are given in detail later on. Again, a common doe in the University goat herd gave scarcely over 550 pounds of milk in a lactation period of six months.

Composition of Goats' Milk.—The composition of goats' milk varies as that of cows' milk, with the breed, period of lactation, and the individuality of the animal. But little information is at hand concerning the composition of the milk of goats of different breeds. So far as known, the milk of the breeds of Swiss origin does not contain as high a percent of butter-fat as that from the Anglo-Nubian or even from some of the common goats. As the doe advances in her period of lactation the fat content of the milk increases. This also varies with other conditions, like intervals between milkings, completeness of milking, etc., so that the test of a single sample of milk will not give a reliable index to the average quality of the milk. This can only be obtained by regular testing of the milk for one or more full days at intervals during the lactation period, in the same way as for dairy cows. A few analyses of goats' milk taken from different sources are given below.

COMPOSITION OF GOATS' MILK (GENEVA, N. Y., AGRICULTURAL EXPERIMENT STATION)

Analyses were made of twenty-three samples of milk from eleven animals:

	Average per cent	Variations per cent
Fat	3.82	1.80– 8.40
Total solids	12.12	9.22–17.63
Total proteins	3.21	2.24– 5.21
Casein	2.40	1.56– 4.06
Ash	.55	.40– .80

Specific gravity, 1.0294.

COMPOSITION OF GOATS' MILK (CALIFORNIA AGRICULTURAL EXPERIMENT STATION)

Analyses of the milk from the does in the University herd are made weekly. The averages given below are the result of the analyses made weekly during the entire lactation periods. With one exception these does were Toggenburgs.

	Average per cent	Variations per cent
Water	88.05	91.5–85.2
Total solids	11.95	9.5–14.8
Fat	3.40	1.7– 5.6
Solids, not fat	8.55	7.8– 9.2

Other sources give the composition of goats' milk as follows:

Authority	Water per cent	Fat per cent	Casein and albumen per cent	Sugar per cent	Ash per cent
Renessc	85.50	4.80	5.00	4.00	.70
Landweinth	85.60	4.60	4.80	4.30	....
Hoffman	86.19	4.73	3.68	4.50	.90
Koenig	86.88	4.07*	3.76	4.64	.85

* Variations, 2.29–7.55 per cent (compiled from about 100 analyses).

Flavor and Odor of Goats' Milk.—Many people believe that all goats' milk has a peculiar "goaty" odor and taste. This is not, however, necessarily the case. A disagreeable flavor is oftentimes due to the presence of a buck in the milking herd; it may also come from the feeding of improper feed. Provided good feed and care are given the doe, and the milk is produced under sanitary conditions, no disagreeable odor or flavor is found in goats' milk, although it has a distinct flavor, different from that of cows' milk.

Length of Lactation Period.—Some of the common goats milk for only four or five months; on the other hand, it is not easy to "dry up" many well-bred does even after they have been milking for ten months. The common goat herd may be improved, however, by the use of pure-bred bucks of known milking strains. A good milch goat should give milk for at least eight months.

USES OF GOATS' MILK

Direct Consumption.—Goats' milk is a common article of diet throughout Europe. Foreign writers agree in attesting to the value of goats' milk for invalids and children. Physicians give testimony as to the beneficial use of goats' milk for infant feeding.

The following quotation from the annual report of the Geneva, N. Y., Agricultural Experiment Station for 1915 is of interest in this connection:

> During the past few years the Station has maintained a herd of milch goats for the purpose of studying not only the cost of maintenance but also the adaptability of the milk to certain uses. The most striking results so far secured relate to the feeding of goats' milk to infants. The Station has had the opportunity of supplying this milk to a fairly large number of very young children who were in serious physical condition, due to their inability to properly digest and assimilate either modified cows' milk or any of the commercial infants' foods that were tried. In nearly all cases of this kind, the physical condition of the children has been built up, and satisfactory growth has been brought about by the use of goats' milk. It is not entirely clear why this milk has proved to be so efficient a food in the instances under observation.[2]

[2] New York (Geneva) Agric. Ex. Sta., Bull. 413, p. 639.

Cheese.—Considerable amounts of cheese are made from goats' milk in Switzerland, France, and other European countries. Such cheese as Mont d'Or, Fromage de St. Marcellin, Neufchatel, and St. Claude are usually made by combining some goats' milk with cows' milk. Neufchatel cheese has been made on a commercial scale in this state; the following directions are given for its manufacture:

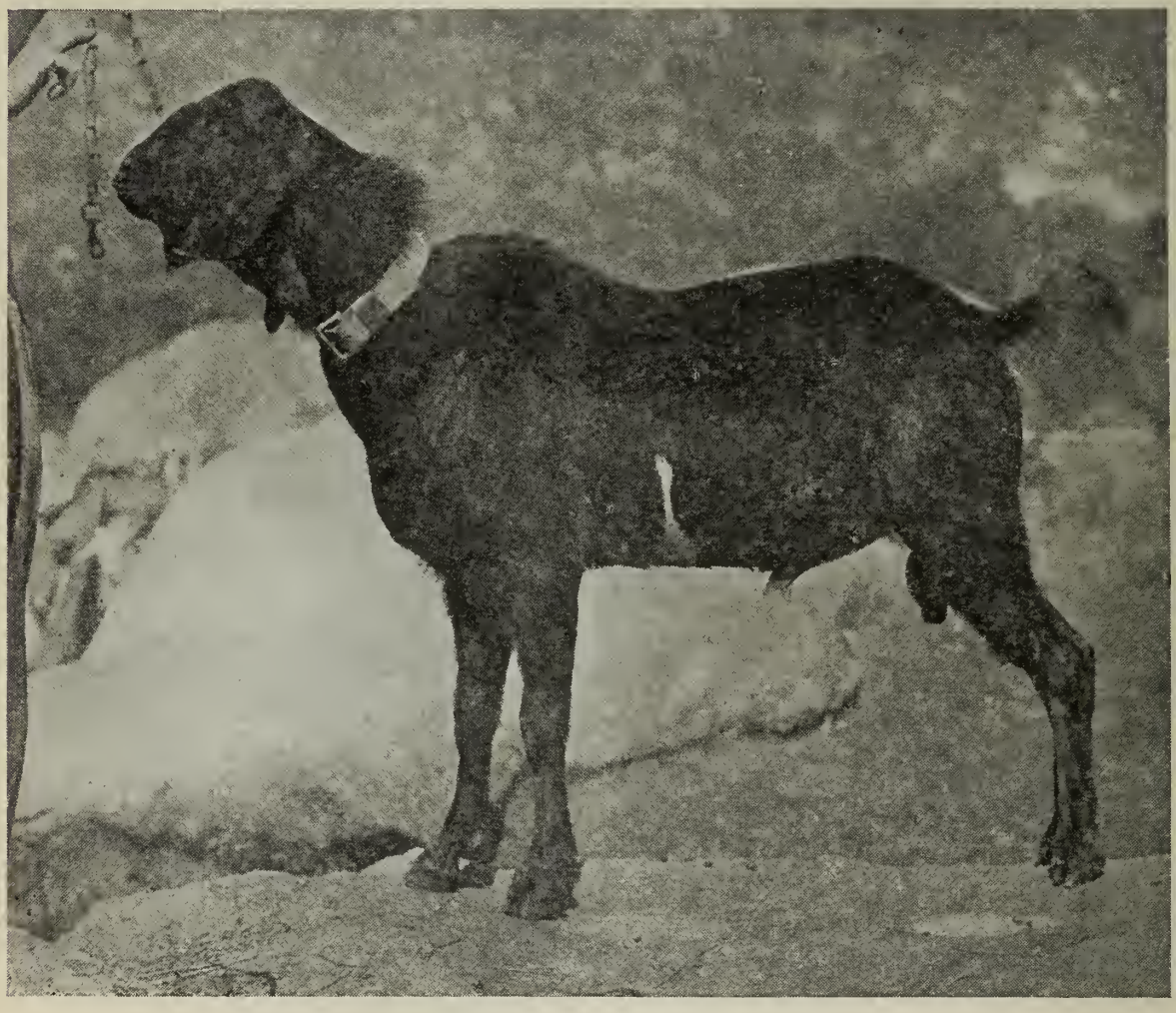

Fig. 6.—Anglo-Nubian buck Banzai Ben Hur.
(Courtesy of Dr. R. J. Gregg, Lakeside, Cal.)

NEUFCHATEL CHEESE

Neufchatel cheese can be made from either goats' or cows' milk, but the former usually makes a smoother, closer-grained cheese. Good, sweet whole milk from morning's and night's milking should be set in the evening. The milk may be either raw or pasteurized, but pasteurization will insure a more uniform cheese as well as kill all pathogenic organisms. For pasteurization, the milk should be heated to 143° F. and held at this temperature for twenty-five minutes, after which it is cooled to the setting temperature. (It may be started in the morning, but by setting at night the different steps in the process may be handled in the daytime.) It is convenient to set the milk in five-gallon shotgun cans. The milk should be tempered to about 70° F. The setting temperature will depend largely upon the air temperature and the apparatus available for holding constant temperature.

If the outside air is colder than 70° F. and the milk is likely to cool down during the night, it would be advisable to set at about 75° F., while if the night air is warmer than 70° F. the setting temperature should be below 70° F.

Setting: Rennet extract is added at the rate of 2½ cubic centimeters per hundred pounds of milk. The rennet should be diluted with about twenty times its volume of cold water before being mixed with the milk. Starter (curdled milk) should be added at the rate of about 50 cubic centimeters per hundred pounds of milk. For average milk about two cubic centimeters of cheese color per hundred pounds of milk will give the desired color in the cheese. In some cases conditions

Fig. 7.—Anglo-Nubian doe kid Inkyo Tolonah at seven months of age.
(Courtesy of Dr. R. J. Gregg, Lakeside, Cal.)

may be such that no color is necessary, while in other cases a higher rate than that above mentioned may be necessary in order to give the proper yellow color to the cheese. After all ingredients are thoroughly mixed with the milk it should be covered and allowed to set for about fifteen to eighteen hours.

The curd is ready to drain when a thin layer of whey shows up at the sides of the can and on top of the curd and the free whey tests from .3 to .4 per cent acidity. A low acidity at the end of eighteen hours indicates too low temperature or insufficient starter; if the acidity is too high it is probably caused by opposite conditions. The curd should then be poured in a draining cloth, using a separate cloth for the contents of each can. Cloth used for this purpose should have a mesh similar to the cloth used for making flour sacks; ordinary cheesecloth allows too much curd to pass through and results in a low yield. These sacks of curd should be suspended and allowed to drain about eight to ten hours. The

temperature of the draining room should be about 60° F. In some cases the cheese may be sufficiently dry after draining for this period, but ordinarily it is necessary to put it under a light pressure after draining in order to remove the excess moist-use. This can be done by tying the top of the draining cloth close to the curd and placing it between two boards with one or two bricks for pressure. The ordinary Frazer cheese hoop and a follower which can be purchased from any

Fig. 8.—Goat brought from Guadaloupe Island.
(Courtesy of E. W. Patrick, Pasadena, Cal.)

dairy supply house is very convenient for pressing the cheese. After pressing over night the curd should be sufficiently dry. The curd is removed from the cloth and mixed with salt at the rate of two ounces of salt to ten pounds of curd. The salt may be mixed more evenly if the curd is first run through a food grinder. After salting, the cheese should be thoroughly mixed and again run through a food grinder to give it a smoother grain.

A good Neufchatel cheese should have a mild, clean flavor and the texture should be smooth and buttery. The moisture should be between 55 and 60 per

cent. A cheese which is too dry will probably be grainy and lumpy, while one containing too much moisture will be very soft.

The cheese is usually molded in a cylindrical form, 1¾ inches in diameter and 2¾ inches long, and wrapped in parchment paper and tinfoil. It may be marketed, however, in small three or four-ounce paper boxes.

Fig. 9.—The goat at the right of the photograph was brought from the Catalina Islands. The next doe, her daughter, sired by a pure-bred Toggenburg buck. The next one is the granddaughter, being three-quarters Toggenburg, while the doe on the extreme left is the great granddaughter, being seven-eighths Toggenburg.

Condensed Milk.—Evaporated milk from goats' milk is now manufactured in a large condensory in Monterey County in this state. It is largely used for infant feeding.

Ices.—Ice cream and ice milk are made of goat cream and milk frozen in the same manner as from cows' milk and cream, and make very pleasing dishes.

Butter.—It is not likely that butter will ever be made commercially from goats' milk. It is, however, occasionally made in a small way; when made by modern methods it has a very good flavor and texture and could be used in the place of ordinary butter.

OTHER GOAT PRODUCTS

Goats' Flesh.—Goat meat is not generally considered a choice article of diet. The flesh of the kid under three months old is tender and has a pleasing flavor to one who likes game. It is generally sold as venison or lamb and should be cooked in the same way as venison. It does not carry enough fat to make it desirable for roasting or frying.

Hides.—The pelts are used in the manufacture of shoes and gloves. The United States imports annually immense numbers of these skins. One of the tanning companies in Napa, California, quotes the following prices (spring, 1917):

No. 1 skins, large and small, 30c per lb. This grade must be free from cuts.

No. 2 skins, 20c per lb. (Classes as No. 2 for being badly taken off, holes in them, etc.)

Dry salt goat skins, 20c per lb.

Very poor and almost worthless stock, 5c per lb.

MILCH GOATS AS BRUSH DESTROYERS

The milch goat, like the Angora, is a destroyer of brushwood, but it cannot be expected that a doe put on rough land with little besides browse to feed on will produce a maximum or even a satisfactory amount of milk of good quality. Kids, on the other hand, are likely to do well on such land. If the goat is merely desired as a destroyer of brush, Angora goats can probably be used to better advantage.

GOATS AS CHILDREN'S PETS

Wethers make very acceptable pets for children. They can very easily be broken to the harness. For this purpose the Anglo-Nubian is unequalled on account of its size.

IMMUNITY TO DISEASE

The goat is an extremely hardy animal and is not subject to a great variety of known animal diseases. Most breeders know how to treat minor ailments, and in case of serious trouble a veterinarian should be called. According to Dr. C. M. Haring of the California

Agricultural Experiment Station, tuberculosis in milch goats is extremely rare.

Malta Fever in Goats.

Malta fever or Mediterranean fever is a matter of most importance to the goat industry in this state. Goats, sheep, cattle, and horses are susceptible to this disease, caused by a special organism, *Micrococeus melitensis.* Through the goat it is transmitted to man. The disease has been endemic to the island of Malta for a long time, but its occurrence has been noted in almost all tropical and subtropical countries. In the United States the disease has been found in New Mexico and Texas, as reported by the Bureau of Animal Industry.

Fig. 10.—Anglo-Nubian wethers make excellent pets for children.
(Courtesy of Phillip Sanger, California.)

As a rule, the disease has no active effect on goats. The most important symptom which is observed among goats affected by Malta fever is the frequency of abortions which result in the course of the disease. Some authors estimate that expulsions of immature fetuses occur in 50 to 90 per cent of the pregnant animals, and abortions in diseased animals reoccur during the succeeding and even at the third gestation following the infection.

The symptoms in other animals are generally imperceptible and the presence of the disease can be determined only by the demonstration of the specific organism in the blood, secretions or excretions.

The symptoms in human beings are more pronounced and give rise to a more or less severe affection.[3]

It is from the standpoint of public health that the disease should be considered. Up to the present time the disease is not known to exist in this state. It is therefore highly important that this disease

[3] U. S. Dept. Agr., Bureau of Animal Industry, Circular 215: Malta Fever with Specific Reference to its Diagnosis and Control in Goats.

is not allowed to enter the state. Care should be taken to have imported animals tested by the combined agglutination and complement-fixation tests.

FEEDING OF MILCH GOATS

The underlying principles of feeding dairy cattle also apply to the feeding of the milch goat, which is a single-purpose animal bred for milk production. On most of the large goat ranches some concentrates are fed, barley, oats, wheat, dried beet pulp, and cocoanut meal being used more largely than any others in this state. The heavier milking does receive as much as two pounds of concentrates per day when in full flow of milk, but rarely over this amount. At the University Farm the goats have been fed a variety of concentrates, viz., cracked corn, linseed meal, and cotton seed meal, besides those mentioned above. Some of the concentrate mixtures fed at the University Farm are as follows:

I.

	Parts by weight
Rolled barley	1
Wheat bran	1
Dried beet pulp	1
Cocoanut meal	1

II.

Dried beet pulp	6
Rolled barley	1
Wheat bran	1
Cocoanut meal	2

III.

Dried beet pulp	1
Wheat bran	1
Oats	1
Cocoanut meal	1

IV.

Dried beet pulp	3
Rolled barley	1
Wheat bran	1

Alfalfa hay is well liked by goats and they do not usually tire of it, but it is well to supplement it with a little grain hay once or twice a week. Both roots and silage are greatly relished by goats. Thistles make a palatable feed when dry—preference being for the seeds, however. Pasturing is the ideal method of feeding. Goats do well both

on alfalfa pasture and on some of the native grasses on rocky and hilly land. The goat enjoys variety, hence it is wise to provide as large a pasture as possible. When goats are kept in a corral, leaves and prunings are very acceptable to them, and even when on pasture this feed is relished greatly. Clean kitchen garbage will be eaten with a relish. Well-kept goats are quite particular in regard to the cleanliness of their feed and drink, and will only do their best when conditions of cleanliness are maintained.

METHODS OF FEEDING

Goats in milk should be fed twice daily. The concentrated portion of the rations is, as a rule, fed in a small box or pan at milking time. When feeding alfalfa hay it is always best to tie the goats and to feed the hay in a rack to prevent waste. Stanchions similar to those used in feeding calves may be used in feeding hay to milch goats. A feeding box used on some goat ranches is made six feet long, two and one-half feet wide, and one foot two inches deep. This is covered with slats to prevent the goats from tossing the hay into the air and wasting it. The goats are usually fastened to this box with snaps.

THE BUCK

The buck is often one of the troublesome features of goateries, and if not managed properly may cause difficulty. He should not be allowed to run with a herd of goats in milk, for the milk will then acquire a "goaty" flavor, the does will likely be bred too early, and the time of breeding will not be known with certainty, which fact prevents necessary attention being given at the time of kidding. The best plan is to remove the buck as far as practicable from the does. He should have his own quarters and pasture, if possible. It is necessary, however, that he be kept in a good vigorous condition throughout the year. During the breeding season some grain should be given. Several bucks can be kept in one enclosure. An occasional vigorous brushing is greatly enjoyed by the buck. Bucks are often infertile, and the testicles of kids should therefore be examined to see whether or not they are large and well formed. If they are small and growth does not seem to take place it is improbable that the buck will prove fertile. Kids of masculine appearance should always be selected for the head of the herd.

The number of does a buck will serve depends largely on his health and robustness; a well-conditioned buck should be able to breed about fifty does.

THE DOE

The doe usually comes in heat once every three weeks, except during the months of July and August. They will breed when very young—before six months of age. However, if early breeding is practiced for many generations, a dwarf stock and mediocre milkers will probably follow. It is recommended that the doe be bred at about eighteen months old, so as to come fresh at two years of age.

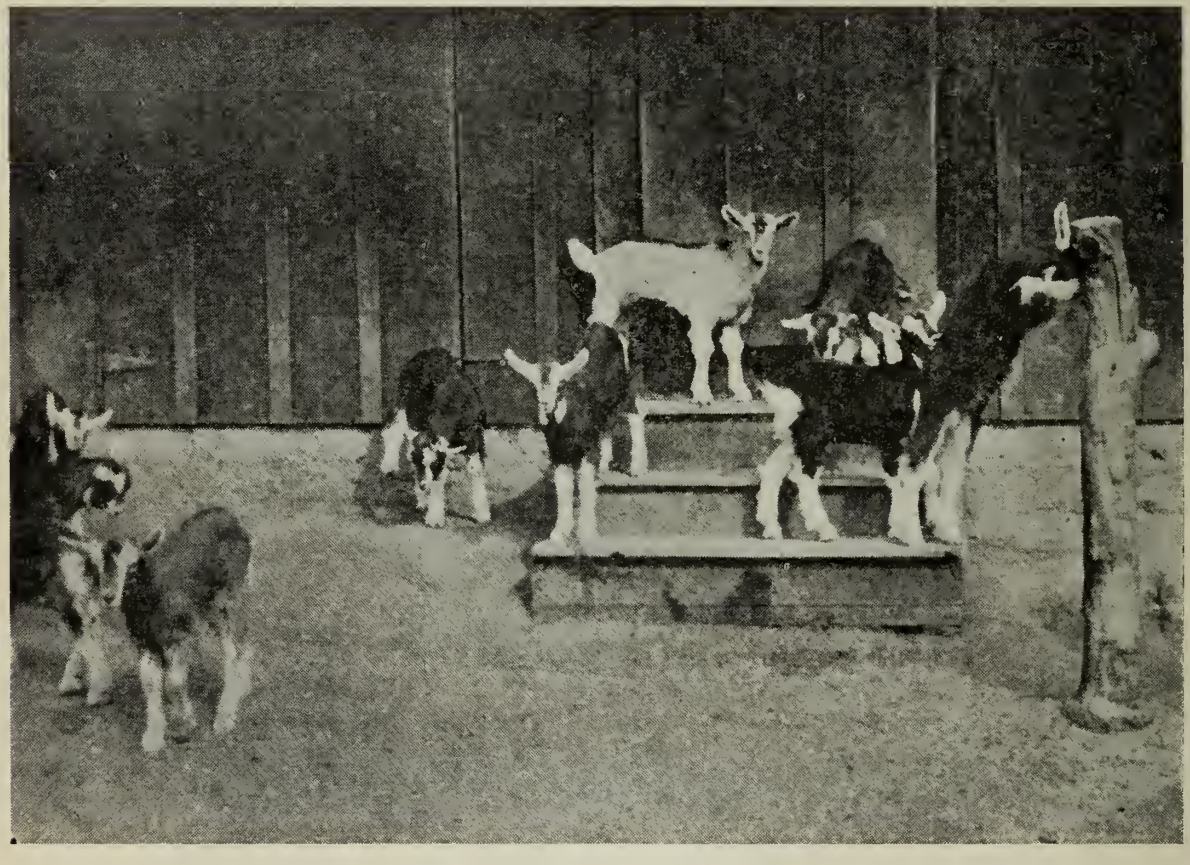

Fig. 11.—Kids, if given plenty of feed and exercise, grow rapidly.

The period of gestation in does is about 152 days. The number of kids at birth is most frequently two, although one, three, or more kids are often dropped. Twins are usually desired because when more come, they are, as a rule, neither as vigorous nor as large as twin kids. Small, unthrifty offspring should be killed at time of birth. It is a good plan to keep the pregnant does alone as much as possible for two or three weeks before kidding. When two or more does are kept together they may fight and hurt each other, causing abortion. At kidding time, warm bran mashes are recommended as being both laxative and cooling. Practically all goat breeders allow the kids to nurse their dams. At first it is probably the best plan to allow the kids to nurse three or even four times daily. If the kids are with

their dams they should not be allowed to roam over very large areas at too early an age. At the University Farm practically all the kids have been successfully raised on the bottle. Taken from their dams at three or four days of age they thrive very well when raised in this way.

In addition to milk the kids have had access to alfalfa hay from the time they were about two weeks old. They have also been fed some grain but never more than one-quarter to one-half pound a day. The following grain mixtures have given satisfaction:

I.

	Parts by weight
Rolled barley	1
Oats	1

II.

Milo (ground)	1
Oats	1

III.

Dried beet pulp	1
Rolled barley	1
Wheat bran	1

It may require some persistency at first to make the kids take milk from the bottle or small pail. Pail feeding has been successful in some cases, but it requires considerable persistency on the part of the attendant at the start. Only kids from good stock should be saved, while all grade males should be destroyed or raised for "venison." The kids should be dehorned when a few days old by using caustic soda. Goats are usually weaned at four or five months of age. Up to three weeks old kids are extremely delicate, but after reaching the age of one month they become hardy and vigorous. They should be kept indoors in dry quarters during rainy weather as they are very sensitive to dampness when young.

CARE OF THE FEET

The feet should be trimmed regularly, especially where the ground is soft. In its native habitat (in rocky regions) the goat keeps its feet worn down. Too much stress cannot be laid on the proper care of the feet.

GOAT HOUSES

Goat houses of almost every style are to be found in California, ranging from piano boxes to well-constructed houses. The houses should be clean, well ventilated, and easily disinfected. The lots

around these houses should be dry and clean. Very valuable goats are preferably kept in box-stalls, of a dimension of 4×5 ft. The sides are composed of one-inch boards placed two inches apart until a height of three feet; above that they are three inches apart. The sides are about four feet six inches high. A goat house can be made of box stalls surrounding an indoor corral; this is very convenient where a considerable number of goats are kept, especially when the weather is disagreeable. Some goat keepers only have a couple of box stalls, in which case a square box-like shed can be built. In such an arrangement a wooden bench on which the goats may sleep at night is put about two feet above the ground. The goat does not care to rest upon soft litter. If straw is provided it will often be scratched away until a hard place is reached. Litter is often necessary to absorb the urine, and nothing better than sawdust for this purpose can be found under California conditions.

MILKING

It is advisable to milk the goat in a place apart from the barn or shed where the does are kept, on account of odors. Either a room boarded off from the remainder of the barn or a milking stand erected in the open does very nicely in this state.

Goats are usually milked on a milking stand large enough for the doe to stand upon, and placed about 2½ feet from the floor or ground. At one end of this stand is a stanchion which fastens the doe while being milked. Before milking the doe should be brushed with a stiff brush and her udder wiped with a damp cloth.

Care of Milk.—As soon as the milk is drawn it should be removed from the goat house, strained and put in a cool place. If promptly cooled to below 60° the milk will keep for several days.

In order to secure definite information as to the milk production of does it is advisable to make a practice of weighing the milk regularly one day each month. By multiplying the yield by the number of days in the month and adding the products for each month in the lactation period, a very satisfactory measure of the milk yield during the period will be obtained.

PRICE OF GOATS

Prices of milch goats vary from $5.00 for does of unknown breeding and no particular milking capacity, up to $300 or more for pure-bred animals. High-class grade females bring from $15.00 to $35.00 at five months of age. Pure-bred bucks and does of good breeding will bring up to $75 at the same age.

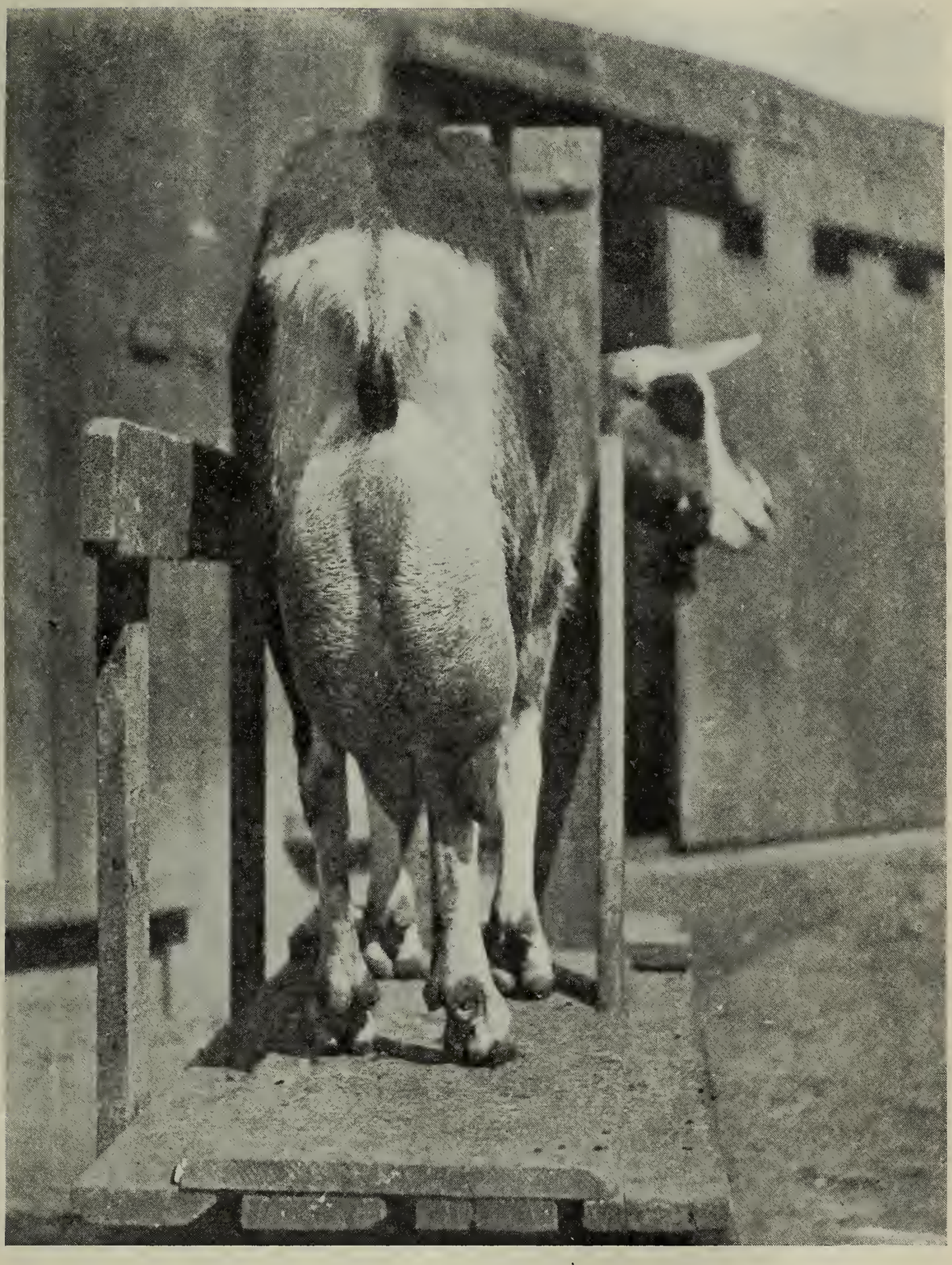

Fig. 12.—Imported Toggenburg doe Fanette in milking stand. (Note the construction of the milking stand.) Fanette has a record of 2680 lbs. of milk in a period of twelve months.

(Courtesy of Mr. Winthrop Howland, Redlands, Cal.)

REGISTRATION

There are two associations taking care of the registrations of milch goats in this country.

The American Milch Goat Record Association registers all breeds of milch goats, whether pure-bred or grades; Secretary, J. C. Darst, Dayton, Ohio.

The International Nubian Breeders' Association confines its efforts to the registration of Nubians or Anglo-Nubians; Secretary, Fred C. Lounsbury, Plainfield, New Jersey.

(B) RESULTS OF EXPERIMENTAL WORK, 1914—1916

FEED REQUIREMENTS OF MILCH GOATS FOR MILK PRODUCTION

An experiment has been conducted with Toggenburg goats at the University Farm during the past three years with a view to determine their feed requirements and capacity for the production of milk, solids, and butter-fat, with special reference to the relative economy of dairy cows and milch goats as milk producers.

Four Toggenburg does were loaned to the University of California for experimental purposes in December, 1913, by Mr. Winthrop Howland of Rancho El Chivar, Redlands, California, viz.,

1. *El Chivar's Hedda,* No. 447 A. M. G. R. A., born December 29, 1909. Pure-bred doe. Bred November 10, 1913, to Prince Tetzel, No. 528 A. M. G. R. A.

2. *El Chivar's Geneva,* No. 651 A. M. G. R. A., born January 31, 1911. Pure-bred doe. Bred October 10, 1913, to Prince Bismarck II, No. 653, A. M. G. R. A.

3. *Delia,* ½ Toggenburg, 1½ years old. Bred September 29, 1913, to Prince Bismarck II, No. 653, A. M. G. R. A.

4. *Delphine,* ¾ Toggenburg, 1½ years old. Bred November 9, 1913, to Prince Bismarck III, No. 988 A. M. G. R. A.

While at the University Farm complete records were kept concerning their care, feed consumption, and production. The goats were placed in box stalls and fed alfalfa hay *ad lib.* and from one to two pounds of grain mixture daily. When the weather permitted they were tethered in the alfalfa fields. Water was before them at all times, and they had access to salt in their box stalls. Records for feed consumption up to the time of kidding are given in the following tables:

FEED CONSUMPTION AND AVERAGE WEIGHT OF DOES, IN POUNDS

Date	Grain	Alfalfa hay	Green feed	Pasture days	Body weight
Delia					
Dec. 18, 1913–Jan. 1, 1914..	23	28	15.5	..	96
Jan. 1–29, 1914	31	35	15.5	4	104
Jan. 29–Feb. 26, 1914	24.5	28	.....	7	106
Feb. 26–Mar. 10, 1914	12	14	.....	7	106
Totals and Averages	90.5	105	31.0	18	103
El Chivar's Geneva					
Dec. 18, 1913–Jan. 1, 1914 ..	23	28	15.5	..	98
Jan. 1–29, 1914	31	35	15.5	4	107
Jan. 29–Feb. 26, 1914	28	28	.....	7	118
Feb. 26–Mar. 15, 1914	21	21	.....	7	.....
Totals and Averages	103	112	31.0	18	108
El Chivar's Hedda					
Jan. 8–29, 1914	15.2	25	7.0	4	100
Jan. 29–Feb.26, 1914	28.0	28	....	7	121
Feb. 26–Mar. 26, 1914	34.4	13	....	24	123
Mar. 26–Apr. 23, 1914	41.4	8	....	28	125
Apr. 23–May 21, 1914	57.4	8	....	91	103
Totals and Averages	176.4	82	7.0	91	114
Delphine					
Jan. 8–29, 1914	18.7	23	7.0	4	90
Jan. 29–Feb. 26, 1914	28.0	28	....	7	92
Feb. 26–Mar. 26, 1914	35.3	13	....	24	97
Mar. 26–Apr. 23, 1914	27.9	8	....	28	103
Apr. 23–May 21, 1914	39.3	8	....	28	134
Totals and Averages	149.2	80	7.0	91	103

Delia was the first doe to kid, viz., on February 20, 1914, after a gestation period of 154 days. This was her first kidding. Three kids (two bucks and a doe) were dropped, weighing 6.5, 6.4, and 4.9 pounds, respectively. The kids were left with their dam until March 10, after which time they were raised by hand.

El Chivar's Geneva kidded on March 11, 1914, after a gestation period of 152 days. She had had previous kiddings. Geneva dropped twin kids (a buck and a doe) weighing 5.8 and 5.9 pounds, respectively. The kids were kept with the dam for four days.

El Chivar's Hedda kidded on April 11, 1914, after a gestation period of 152 days. Hedda had had previous kiddings. She dropped

triplets (two bucks and one doe), weighing 5.8, 5.6, and 5.1 pounds, respectively. Hedda's kids were not separated from her until May 21, 1914.

Delphine kidded on April 12, 1914, after a gestation period of 154 days. This was Delphine's first kidding. She dropped twin kids (a buck and a doe), weighing 5.0 and 4.6 pounds, respectively. These kids were left with their dam as Delphine's teats were so short that it was next to impossible to milk her. She died from pneumonia shortly after kidding.

Records for production and feed consumption for two other pure-bred Toggenburg does have been kept, viz., El Chivar's Gretel, No. 1022 A. M. G. R. A., and El Chivar's Hertha, No. 1023 A. M. G. R. A. The former kidded on April 6, 1915, dropping twins (a horn-less doe and a horned buck). The buck kid weighed seven pounds at birth, while the doe kid's weight was six pounds.

El Chivar's Gretel was born March 11, 1914, making her one year and twenty-six days old at the time of kidding.

El Chivar's Hertha, No. 1023 A. M. G. R. A., kidded on April 6, 1915, dropping twins. Hertha was born April 11, 1914, making her just one year old at the time she kidded.

The following records give the complete milk yields of the five does during the lactation periods and the amounts of feed consumed during that time:

DELIA

Date, 1914	Weight, lbs.	Production: Lbs. milk	Production: Solids Per cent	Production: Solids Lbs.	Production: Fat Per cent	Production: Fat Lbs.	Feed Consumption: Grain	Feed Consumption: Alfalfa hay	Feed Consumption: Green alfalfa	Past. days
3/10– 3/26	103	87.7	14.0	12.31	4.67	4.10	24.6	6.0	.....	14
3/26– 4/23	100	175.6	13.0	22.87	3.86	6.79	72.1	8.0	.....	28
4/23– 5/21	108	162.8	12.6	20.63	3.56	5.70	59.4	8.0	.....	28
5/21– 6/18	105	142.2	12.2	17.38	3.49	4.97	12.0	64.4	239.5	7
6/18– 7/16	103	133.5	12.0	16.05	3.56	4.76	.....	54.1	421.0	....
7/16– 8/12	100	128.0	11.8	15.11	3.35	4.29	.....	34.8	434.0	....
8/12– 9/10	103	118.9	11.9	14.20	3.30	3.93	.....	30.4	430.0	....
9/10–10/8	103	89.5	12.7	11.35	3.80	3.40	.....	35.9	341.0	....
10/8 –11/5	105	86.0	13.5	11.60	4.50	3.83	.....	62.0	303.0	....
11/5 –12/3	101	80.8	14.2	11.46	4.88	3.94	.....	54.0	350.0	....
12/3 –12/31	103	54.6	14.6	7.98	5.20	2.83	.....	186.0	38.0	....
1915										
12/31– 1/14	109	23.7	14.3	3.40	5.90	1.19	.....	105.0	.....	....
310 days	104	1283.3	12.88	164.34	3.88	49.73	16.81	648.6	2556.5	77

Total feed units	862.4
Total units per 100 lbs. milk	67.2
Total units per 1 lb. fat	17.3

Geneva

Date, 1914	Weight, lbs.	Production: Lbs. milk	Solids: Per cent	Solids: Lbs.	Fat: Per cent	Fat: Lbs.	Feed Consumption: Grain	Alfalfa hay	Green alfalfa	Past. days
3/15– 3/26	120	67.6	13.8	9.34	4.74	3.21	18.3	3.0	.....	11
3/26– 4/23	123	230.6	12.5	28.80	3.79	8.75	71.5	8.0	.....	28
4/23– 5/21	139	271.9	11.8	32.21	3.19	8.70	55.8	8.0	.....	28
5/21– 6/18	124	260.2	11.6	30.30	2.95	7.68	71.7	56.0	216.9	7
6/18– 7/16	126	260.6	10.9	28.65	2.80	7.29	78.8	50.0	374.5	....
7/16– 8/12	129	251.2	10.8	27.18	2.75	6.90	26.7	26.7	329.2	....
8/12– 9/10	134	212.7	11.3	24.06	2.93	6.24	56.0	18.2	309.3	....
9/10–10/8	125	150.4	11.1	17.65	3.30	4.97	50.0	37.8	290.0	....
10/8 –11/5	127	145.1	12.2	17.60	3.80	5.46	42.0	60.0	289.0	....
11/5 –12/3	124	124.2	13.3	16.46	4.51	5.59	42.0	64.0	301.0	....
12/3 –12/31	122	110.2	13.2	14.50	4.40	4.78	35.0	186.0	38.0	....
1915 12/31– 1/21	135	73.3	15.2	9.60	5.10	3.23	14.0	155.0	.....	....
312 days	127	2158.0	11.9	256.34	3.37	72.80	615.6	672.7	2147.9	74

Total feed units	1264.2
Feed units per 100 lbs. milk	58.5
Feed units per 1 lb. fat	17.3

Hedda

Date, 1915	Weight, lbs.	Production: Lbs. milk	Solids: Per cent	Solids: Lbs.	Fat: Per cent	Fat: Lbs.	Feed Consumption: Grain	Alfalfa hay	Green alfalfa	Past. days
5/14– 5/21	.....	28.0	12.3	3.44	4.60	1.29	14.0	6.0	.....	7
5/21– 6/18	124	177.9	12.5	22.25	3.59	6.48	14.0	64.4	239.5	7
6/18– 7/16	120	114.3	12.0	20.91	3.44	6.00	.....	54.1	421.0	....
7/16– 8/12	116	161.3	11.7	18.91	3.18	5.12	.....	34.8	434.0	....
8/12– 9/10	121	128.3	11.7	14.95	3.02	3.87	.....	30.4	430.0	....
9/10–10/8	115	110.0	11.7	12.93	3.60	3.93	.....	35.9	341.0	....
10/8 –11/5	116	102.6	12.7	13.10	4.00	4.14	.....	62.0	303.0	....
11/5 –12/3	113	101.8	13.4	13.72	4.23	4.31	.....	54.0	350.0	....
12/3 –12/31	116	78.5	14.0	11.00	4.50	3.49	.....	186.0	38.0	....
1915 12/31– 1/21	132	55.3	12.8	7.10	3.80	2.07	.....	155.0	.....	....
245 days	119	1118.0	12.37	138.31	3.64	40.70	28.0	682.6	2556.5	14

Total feed units	642.0
Feed units per 100 lbs. milk	57.4
Feed units per 1 lb. fat	15.8

El Chivar's Gretel

Date, 1915	Weight, lbs.	Production: Lbs. milk	Solids: Per cent	Solids: Lbs.	Fat: Per cent	Fat: Lbs.	Feed Consumption: Grain	Alfalfa hay	Green alfalfa	Past. days
4/15– 5/13	90	208.7	12.6	26.3	3.6	7.53	45.0	112	....	28.0
5/13– 6/10	90	210.0	11.4	24.0	2.8	5.93	45.3	102	37	17.5
6/10– 7/8	89	187.9	10.8	20.3	2.5	4.71	41.9	69	....	17.5
7/8 – 8/5	90	181.0	10.8	19.5	2.6	4.75	45.3	74	32	10.5
8/5 – 9/2	97	176.9	9.8	17.4	2.1	3.72	55.6	98	....	24.5
9/2 – 9/30	104	155.8	10.4	16.3	2.6	3.99	55.6	84	....	28.0
9/30–10/28	102	122.9	11.0	13.5	3.1	3.81	42.0	84	....	28.0
10/28–11/25	102	80.7	12.0	9.7	3.6	2.92	42.0	87	25	10.5
11/25–12/23	98	65.0	12.6	8.2	4.0	2.58	19.0	83	25	.....
1916										
12/23– 1/20	97	66.3	12.4	8.2	3.5	2.04	19.0	67	....	.....
1/20– 2/17	95	57.1	11.3	7.7	2.5	1.41	14.0	57	....	.....
2/17– 3/16	91	40.9	12.5	5.1	3.9	1.61	11.0	44	....	.....
	95	1553.2	11.3	176.2	2.89	45.01	435.7	961	119	164.5

Grain made up as follows: 43.6 lbs. bran, 160.1 lbs. barley, 13.3 lbs. corn, 152 lbs. oats, 19.2 lbs. linseed oil meal, 38.7 lbs. cocoanut oil meal, 7.8 lbs. dried beet pulp.

Total feed units	1081.4
Feed units per 100 lbs. milk	69.6
Feed units per 1 lb. fat	24.0

El Chivar's Hertha

Date 1915	Weight, lbs.	Production: Lbs. milk	Solids: Per cent	Solids: Lbs.	Fat: Per cent	Fat: Lbs.	Feed Consumption: Grain	Alfalfa hay	Green alfalfa	Past. days
4/15– 5/13	74	166.6	12.1	20.2	3.1	5.22	27.7	112	....	28.0
5/13– 6/10	76	160.3	11.3	18.1	2.8	4.45	27.6	102	37	17.5
6/10– 7/8	85	151.5	10.6	16.0	2.4	3.69	27.5	69	....	17.5
7/7 – 8/5	81	138.9	10.7	14.8	2.6	3.64	27.6	18	32	21.0
8/5 – 9/2	82	130.7	9.8	12.8	2.1	2.69	38.4	98	....	24.5
9/2 – 9/30	89	123.2	10.7	13.1	2.5	3.04	27.6	84	....	28.0
9/30–10/28	100	92.2	11.4	10.5	2.9	2.71	27.6	84	....	28.0
10/28–11/25	95	90.1	11.5	10.4	2.9	2.64	27.6	87	25	10.5
11/25–12/23	93	88.3	12.6	11.1	3.8	3.33	19.0	83	....	.....
1916										
12/23– 1/20	82	77.8	12.6	9.8	3.8	2.96	25.0	67	....	.....
1/20– 2/17	84	68.2	12.2	8.3	3.3	2.28	14.0	57	....	.....
2/17– 3/16	85	53.8	12.6	6.8	3.7	2.021	11.4	46	....	.....
	86	1341.6	11.3	151.9	2.88	38.67	301.0	907	94	175.0

Grain consists of: 26.8 lbs. bran, 115.1 lbs. barley, 9.4 lbs. corn, 109.2 lbs. oats, 12.1 lbs. linseed oil meal, 23.3 lbs. cocoanut oil meal, 5.1 lbs. dried beet pulp.

Total feed units	933.0
Feed units per 100 lbs. milk	68.1
Feed units per 1 lb. fat	24.1

In calculating the cost of feeding the goats the following average feed prices have been assumed:

Barley	$29.50 per ton
Corn	29.50 per ton
Oats	34.00 per ton
Linseed oil meal	38.50 per ton
Cocoanut oil meal	24.00 per ton
Dried beet pulp	22.00 per ton
Wheat bran	27.00 per ton
Alfalfa hay	10.50 per ton
Green alfalfa	2.50 per ton
Pasture	.20 per month

The following table presents the results of the calculation in regard to the total cost of the feed eaten by the five does during the year, and the feed cost per gallon of milk and pounds of butter-fat:

Name	Total cost of feed	Cost of feed per gal. milk	Cost of feed per lb. fat
Delia	$9.72	6.5c	19.6c
Geneva	16.10	6.4c	22.1c
Hedda	7.02	5.4c	17.2c
Gretta	12.63	6.9c	28.0c
Hertha	10.71	6.8c	27.6c
Average	$11.24	6.4c	22.9

It will be noted that the feed eaten by the goats for the entire year cost, on the average, $11.25 per ton at current market prices during the past five years, and that the feed cost of a gallon of milk and a pound of fat was 6.4c and 22.9c, respectively.

The complete records of production of the cows in the University dairy herd are available for the past four years. At the present time, seventy-three entire lactation periods for dairy cows have been completed, in which accurate records of production and feed eaten by the cows have been kept. These lactation periods include those of twenty-two Holstein cows, sixteen Jerseys, nine Guernseys, four Ayrshires, eight grade Holsteins, and fourteen grade Shorthorns. Using the same prices for feed as for the milch goats we find that for the average number of lactation periods given, the feed cost of a gallon of milk was 8.3c, and of a pound of fat 24.4c. A comparison between the feed cost of a gallon of milk and per pound of butter fat for the milch goats and the dairy cows in the University herd, therefore, shows that the former produced a gallon of milk at a cost of 1.9c lower than the cows, a difference of 23 per cent, and a pound

of butter-fat at a cost of 1.7c lower, a difference of 7 per cent. It should be noted that the goats in this experiment were animals with excellent milk-producing capacity and doubtless considerably above the average for the breed. It is possible that with a large herd the cost of production would be more nearly equal to the cost of production by dairy cows.

It is probable that the interest in milch goats will continue to grow. One of the chief drawbacks to the industry in the near future is likely to be the many poor individuals on the market. The general public should understand that there is a vast difference between the good and the poor producers among milch goats. The main characteristics of a good producer are an angular form, a large barrel (abdomen), which with a strong, muscular jaw indicates good feeding capacity, a large udder of good texture, with good-sized teats. A certain refinement and "quality" are further indications of a good milch goat.

The future of the goat industry in this state would seem to lie in several directions: (1) The use of milk for direct consumption of the family; (2) as food for infants and invalids; (3) the making of cheese from the milk; (4) the breeding of high-producing animals.

Unlike conditions in European countries, milch goats are not kept in this country to any great extent by laboring people who depend on the goat for their entire milk supply. On the contrary, they are kept by many well-to-do people, especially in southern California.

A single milch goat can be fed at a very low cost on kitchen waste, lawn clippings, grass growing on vacant city lots and along roadways, etc., and the only expense will be for a little grain while in milk and for hay when no green feed is available. By depending on the milch goat for its milk supply, a family may reduce the milk bill very materially, and secure for feeding its members a food article of fully equal nutritive value to that of cows' milk, and in the opinion of eminent physicians, superior to the same so far as the feeding of infants and invalids is concerned. The latter point offers another opportunity for profit. Owners of goats can often rent their goats in milk, especially in cases where goats' milk has been prescribed for infants and invalids by physicians.

Attention has already been called to the fact that milch goats vary greatly in regard to milk production, and care must therefore be taken to secure good individuals, which must, moreover, be in perfect health. A standard of three or four quarts of milk per day shortly after kidding is none too high.

Goats may be kept to advantage on small fruit ranches, and on high-priced land where there is not sufficient feed to support a cow.

Furthermore, on rocky and hilly land, but little adapted to dairying, a herd of milch goats may be maintained in good production at a small feed cost, which will supply sufficient milk both for the use of the family and neighbors as well.

Such conditions prevail in many inaccessible places, like mining and lumbering camps where people now ordinarily depend on condensed milk for their milk supply. The great advantage of goats in

Fig. 13.—Herd of goats in the hills of Southern California.

such places is that, unlike dairy cattle, goats "always come home at night."

There is a strong demand at the present time for milch goats, which is likely to increase in the future. Goat raising for supplying milch animals will therefore undoubtedly prove profitable and is worthy of the attention of interested people who can engage in the business of breeding goats and are familiar with this class of livestock. Milch goats are likely to be kept in large numbers only by such breeders, and by ranchers who supply goats' milk for the manufacture of cheese or condensed milk. The large majority of people keeping milch goats, whether in towns or in the country, will

keep one or two animals only for supplying their own needs. The future of the goat industry will depend primarily on the extent to which these people take advantage of the special opportunities for securing a valuable, necessary food product at a minimum cost that goat keeping offers.

BIBLIOGRAPHY

Information Concerning Milch Goats, by Geo. Fayette Thompson. Bureau of Animal Industry, U. S. Department of Agriculture, Bulletin 68, 1905. (May be obtained from the Superintendent of Documents, Washington, D. C. Price, 15 cents.)

The Book of the Goat, by Henry Stephens Holmes Pegler. L. Upton Gill, 170 Strand, London, W. C., 1909.

Profit and Pleasure in Goat-Keeping, by Fred C. Lounsbury. Published by the author, Plainfield, N. J., 1915.

Money in Goats, by W. Sheldon Bull. Published by the author, Buffalo, N. Y., 1915.

Goats' Milk for Infant Feeding, by W. H. Jordan and G. A. Smith. Geneva, N. Y., Agricultural Experiment Station, Bulletin 429.

The Casein and Salts in Goats' Milk, by A. W. Bosworth and L. L. Van Slyke. Geneva, N. Y., Agricultural Experiment Station, Technical Bulletin 46, 1915.

Malta Fever, with Special Reference to its Diagnosis and Control in Goats, by John R. Mohler and Adolph Eichhorn. Bureau of Animal Industry, U. S. Department of Agriculture, Circular 215.

Takosis, A Contagious Disease of Goats, by John R. Mohler and Henry J. Washburn. Bureau of Animal Industry, U. S. Department of Agriculture, Bulletin 45.

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

REPORTS

1897. Resistant Vines, their Selection, Adaptation, and Grafting. Appendix to Viticultural Report for 1896.
1902. Report of the Agricultural Experiment Station for 1898–1901.
1903. Report of the Agricultural Experiment Station for 1901–03.
1904. Twenty-second Report of the Agricultural Experiment Station for 1903–04.
1914. Report of the College of Agriculture and the Agricultural Experiment Station, July, 1913–June, 1914.
1915. Report of the College of Agriculture and the Agricultural Experiment Station, July, 1914–June, 1915.
1916. Report of the College of Agriculture and the Agricultural Experiment Station, July, 1915–June, 1916.

BULLETINS

No.

230. Enological Investigations.
241. Vine Pruning in California, Part I.
242. Humus in California Soils.
244. Utilization of Waste Oranges.
246. Vine Pruning in California, Part II.
248. The Economic Value of Pacific Coast Kelps.
249. Stock-Poisoning Plants of California.
250. The Loquat.
251. Utilization of the Nitrogen and Organic Matter in Septic and Imhoff Tank Sludges.
252. Deterioration of Lumber.
253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.
255. The Citricola Scale.
257. New Dosage Tables.
261. Melaxuma of the Walnut, "Juglans regia."
262. Citrus Diseases of Florida and Cuba Compared with Those of California.
263. Size Grade for Ripe Olives.
264. The Calibration of the Leakage Meter.
265. Cottony Rot of Lemons in California.
266. A Spotting of Citrus Fruits Due to the Action of Oil Liberated from the Rind.

No.

267. Experiments with Stocks for Citrus.
268. Growing and Grafting Olive Seedlings.
270. A Comparison of Annual Cropping, Biennial Cropping, and Green Manures on the Yield of Wheat.
271. Feeding Dairy Calves in California.
272. Commercial Fertilizers.
273. Preliminary Report on Kearney Vineyard Experimental Drain.
274. The Common Honey Bee as an Agent in Prune Pollination.
275. The Cultivation of Belladonna in California.
276. The Pomegranate.
277. Sudan Grass.
278. Grain Sorghums.
279. Irrigation of Rice in California.
280. Irrigation of Alfalfa in the Sacramento Valley.
281. Control of the Pocket Gophers in California.
282. Trials with California Silage Crops for Dairy Cows.
283. The Olive Insects of California.
284. Irrigation of Alfalfa in Imperial Valley.
285. The Milch Goat in California.

CIRCULARS

No.

82. The Common Ground Squirrels of California.
107. Spraying Walnut Trees for Blight and Aphis Control.
108. Grape Juice.
109. Community or Local Extension Work by the High School Agricultural Department.
113. Correspondence Courses in Agriculture.
114. Increasing the Duty of Water.
115. Grafting Vinifera Vineyards.
117. The Selection and Cost of a Small Pumping Plant.
118. The County Farm Bureau.
121. Some Things the Prospective Settler Should Know.
124. Alfalfa Silage for Fattening Steers.
126. Spraying for the Grape Leaf Hopper.
127. House Fumigation.
128. Insecticide Formulas.
129. The Control of Citrus Insects.
130. Cabbage Growing in California.
131. Spraying for Control of Walnut Aphis.
132. When to Vaccinate against Hog Cholera.
133. County Farm Adviser.
134. Control of Raisin Insects.
135. Official Tests of Dairy Cows.
136. Melilotus Indica.
137. Wood Decay in Orchard Trees.
138. The Silo in California Agriculture.
139. The Generation of Hydrocyanic Acid Gas in Fumigation by Portable Machines.
140. The Practical Application of Improved Methods of Fermentation in California Wineries during 1913 and 1914.
141. Standard Insecticides and Fungicides versus Secret Preparations.

No.

142. Practical and Inexpensive Poultry Appliances.
143. Control of Grasshoppers in Imperial Valley.
144. Oidium or Powdery Mildew of the Vine.
145. Suggestions to Poultrymen concerning Chicken Pox.
146. Jellies and Marmalades from Citrus Fruits.
147. Tomato Growing in California.
148. "Lungworms."
150. Round Worms in Poultry.
151. Feeding and Management of Hogs.
152. Some Observations on the Bulk Handling of Grain in California.
153. Announcement of the California State Dairy Cow Competition, 1916–18.
154. Irrigation Practice in Growing Small Fruits in California.
155. Bovine Tuberculosis.
156. How to Operate an Incubator.
157. Control of the Pear Scab.
158. Home and Farm Canning.
159. Agriculture in the Imperial Valley.
160. Lettuce Growing in California.
161. Potatoes in California.
162. White Diarrhoea and Coccidiosis of Chicks.
163. Fundamentals Affecting the Food Supply of the United States.
164. Small Fruit Culture in California.
165. Fundamentals of Sugar Beet under California Conditions.
166. The County Farm Bureau.
167. Feeding Stuffs of Minor Importance.
168. Spraying for the Control of Wild Morning-Glory within the Fog Belt.